



Product Information

Issued Date : Aug 17, 2006

SAMSUNG TFT-LCD

MODEL NO. : LTB230W1-L01

Note:

Samsung Electronics Co . , LTD.





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General Description

* Description

LTB230W1-L01 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFTs as a switching devices. This model is composed of a TFT LCD panel, a driver circuit and a back-light system. The resolution of a 23.0" contains 1366 x 768 pixels and can display up to 16.7 million colors with wide viewing angle of 90° or higher in all directions.

* Features

- High contrast ratio, high aperture structure
- SPVA (**S**uper **P**atterned **V**ertical **A**lign) mode
- Wide viewing angle ($\pm 180^\circ$)
- High speed response
- WXGA (1366 x 768 pixels) resolution (16:9)
- Low Power consumption
- 6 Direct U-Type CCFL (Cold Cathode Fluorescent Lamp)
- LVDS (Low-Voltage Differential Signal) interface.(1pixel/clock)

* Applications

- Workstation & desktop monitors
- Indoor Advertising
- Display terminals for AV application products
- Monitors for industrial Machine

* If the module is used to other applications besides the above, please contact SEC in advance.

General information

Items	Specification	Unit	Note
Display area	508.125(H) × 285.696(V)	mm	
Outline Dimension	546.0(H)×318.3(V)×46.3(D)	mm	Typical Value
	544.0(H)×316.3(V)×44.3(D)		Min Value
	548.0(H)×320.3(V)×48.3(D)		Max Value
Driver element	a-Si TFT active matrix		
Display colors	16.7M (true)	colors	16,777,216
Number of pixels	1366 x 768	pixel	16:9
Pixel pitch	0.372(H) × 0.372(W)	mm	
Display mode	Normally Black		
Surface treatment	Haze 44%, Hard-coating(3H)		conductive pol
Weight	3100 (Max)	g	

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1. Absolute Maximum Ratings

1.1 Absolute ratings of environment

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T _{STG}	-20	65	°C	(1)
Operating temperature (Ambient temperature)	T _{OPR}	0	50	°C	(1)
	T _{sur}	0	65	°C	(2)
Shock (non - operating)	Snop	-	50	G	(3),(5)
Vibration (Non - operating)	Vnop	-	1.5	G	(4),(5)

Note (1) Temperature and relative humidity range are shown in the figure below.

93.8 % RH Max. (40 °C ≥ Ta)

Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

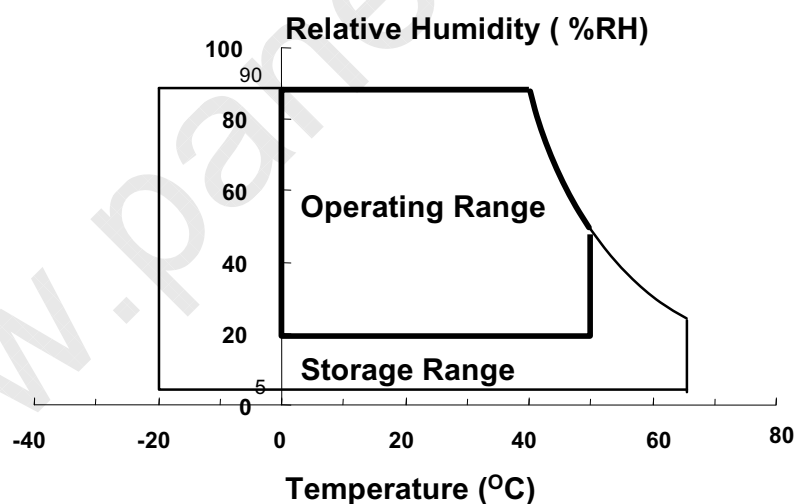
(2) Abnormal visual problems by panel surface temperature can be occurred in specific range. But materials(ex : polarizer) are not damaged permanently in this range, T_{sur}.

(3) 11ms, sine wave, 1 time for ±X, ±Y, ±Z axis

(4) 10~300Hz/1.5G

(10min/cycle, 30min for X,Y,Z axis)

(5) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.



1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD Module

(V_{ss} = GND = 0 V)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	LCD Module VDD	V _{ss} -0.5	6.5	V	(1)
	Inverter VCC	21.6	26.4	V	

NOTE (1) Within Ta (25 ± 2 °C)



2. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).

◆ Measuring equipment : SR-3 , RD-80S (TOPCON) , EZ-Contrast(Eldim)

* Ta = 25 ± 2°C , VDD=5.0V, fv= 60Hz, fdCLK=75 MHz, IL = 5.3mA_{rms}

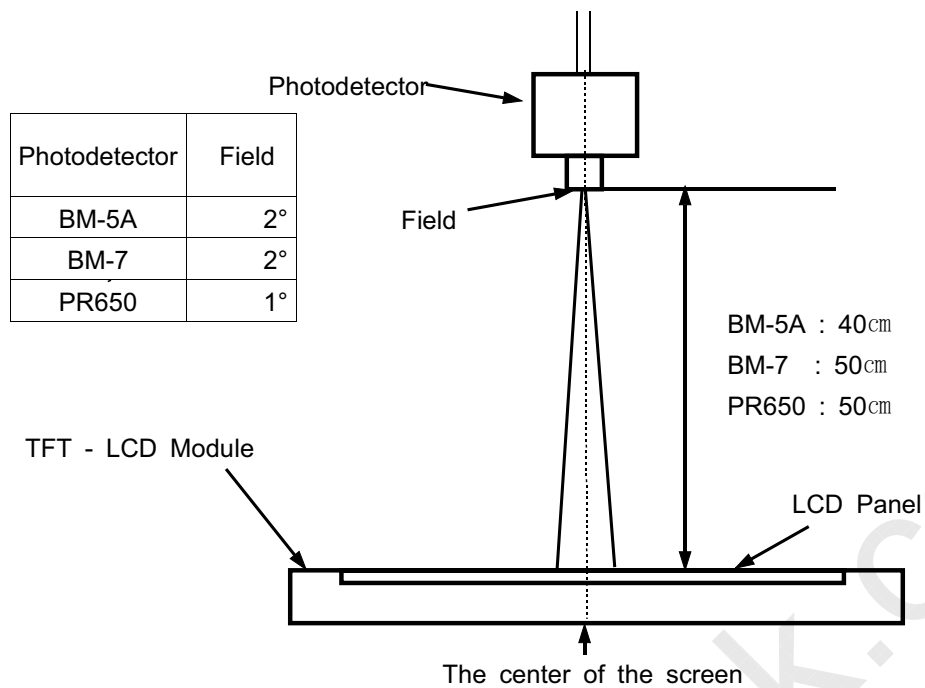
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\phi = 0$ $\theta = 0$	800	1000	-		(3) SR-3
Response Time	On+Off	Tr+Tf		-	25	35	msec	(4) RD-80S
	Gray to Gray	T _{G-G}		-	8			
Luminance of White (Center of screen)		YL			300	350	-	cd/m2
Color Chromati city (CIE 1931)	Red	R _x	Viewing Angle	TYP. -0.03	0.643	TYP. +0.03		(6) SR-3
		R _y			0.329			
	Green	G _x			0.286			
		G _y			0.591			
	Blue	B _x			0.144			
		B _y			0.063			
	White	W _x			0.280			
		W _y			0.290			
Color Temperature		k		-	10000	-		
Viewing Angle	Hor.	θ L	C/R≥10	80	90	-	Degrees	(7) EZ-Contrast
		θ R		80	90	-		
	Ver.	ϕ H		80	90	-		
		ϕ L		80	90	-		
Brightness Uniformity (9 points)		Buni		-	-	25	%	(8) SR-3

Note 1) Test Equipment Setup

After stabilizing and leaving the panel alone at a given temperature for 60 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 60 min after lighting the back-light. This should be measured in the center of screen.

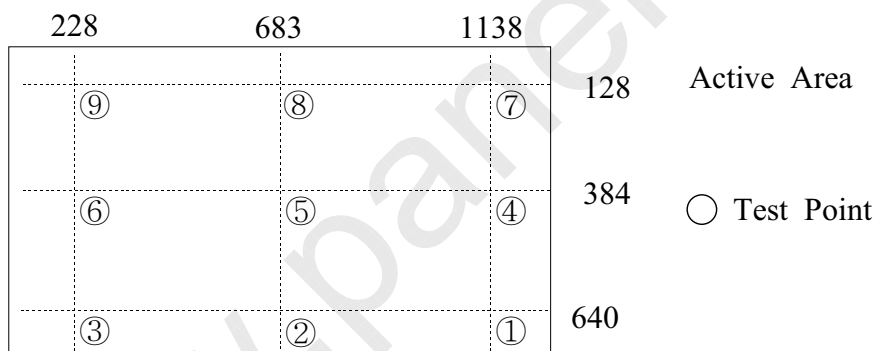
A single lamp current : 5.3 mA

Environment condition : Ta = 25 ± 2 °C



Optical Measuring Equipment Setup

Note 2) Definition of test point



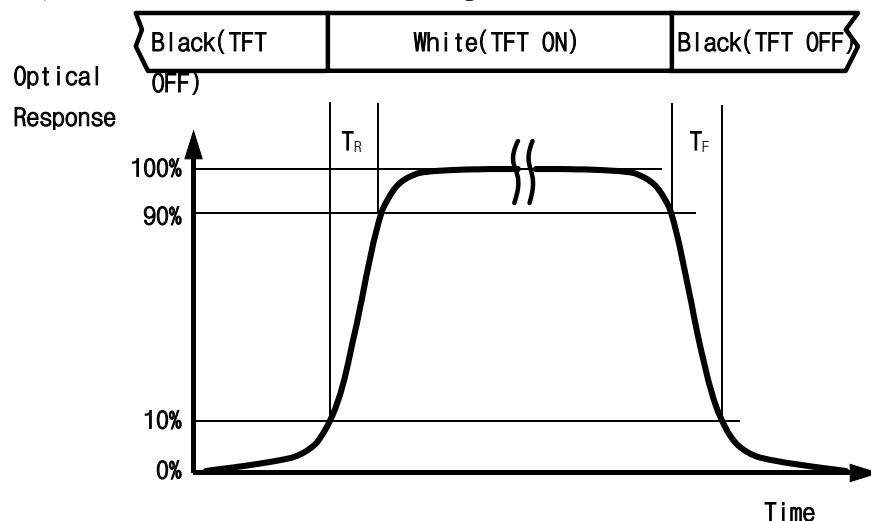
Note 3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point(5) of the panel

$$CR = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

Note 4) ① Definition of On/Off Response time : Sum of T_R , T_F



② Gray to Gray Response Time

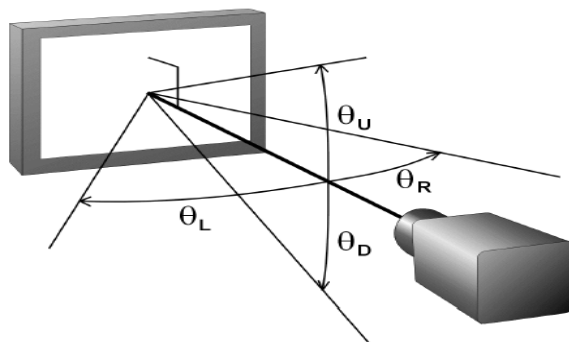
- measuring gray : 31→ 63, 63→ 95, 95→127, 127→159, 159→191, 191→223, 223→255 grays and vice versa
- TG-G, avg : average response time of ones between above grays

Note 5) Definition of Luminance of White : Luminance of white at center point(5).

Note 6) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red , Green , Blue & White at center point(5).

Note 7) Definition of Viewing Angle : Viewing angle range ($CR \geq 10$)



Note 8) Definition of 9 points brightness uniformity

$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

B_{max} : Maximum brightness

B_{min} : Minimum brightness

3.2 BACK-LIGHT UNIT

The back-light system contains direct - lighting U-type with 6 CCFTs (Cold Cathode Fluorescent Tube)

- Life time (Hr) of a lamp, 50,000hours, is defined as the time in which it continues to operate under the condition of $T_a = 25 \pm 2^\circ\text{C}$ and Typical Luminance for a lamp until the brightness becomes 50% or lower than it's original value.

3.2.1 Inverter Input Condition & Specification

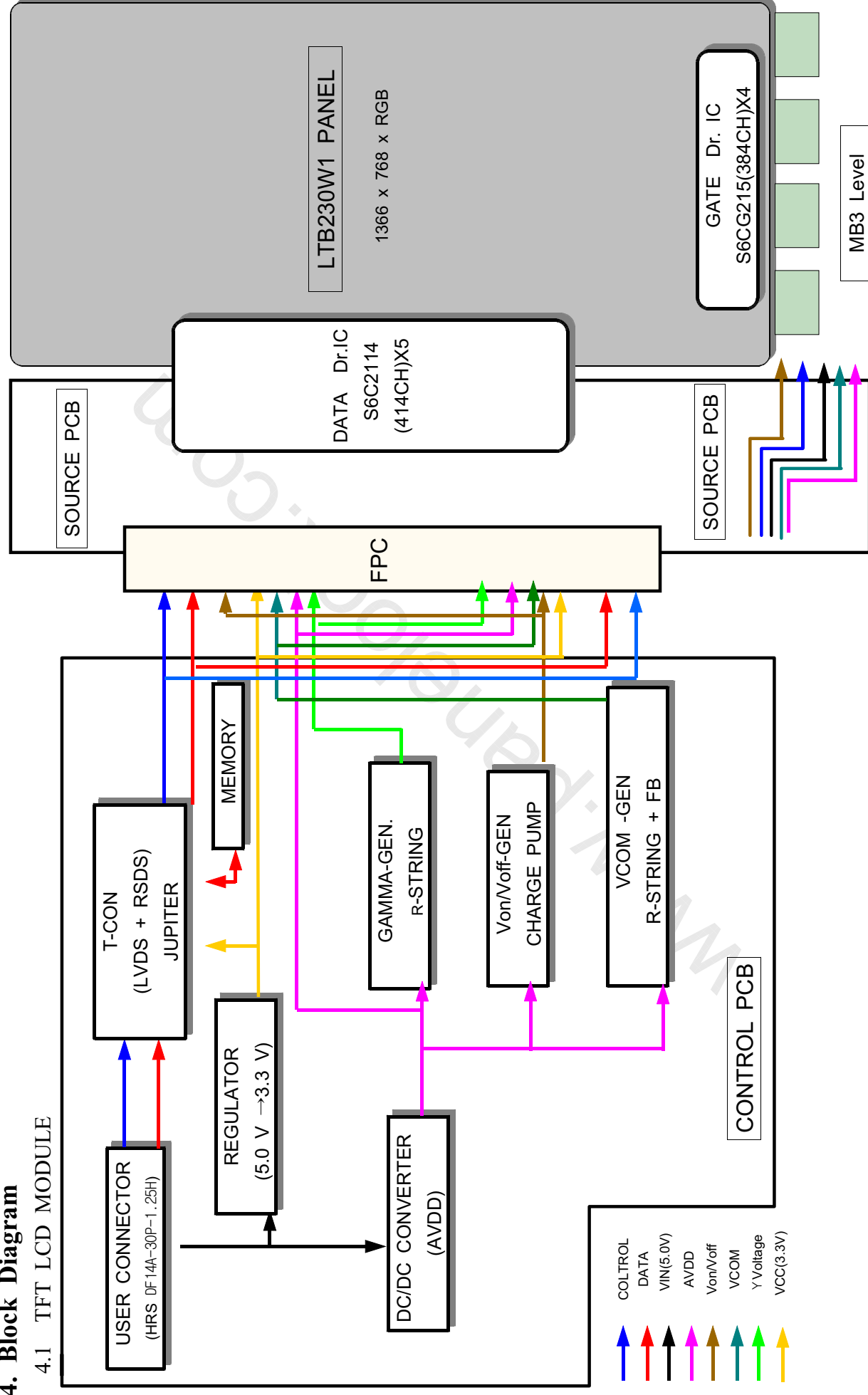
Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	Vin	-	21.6	24	26.4	V	Ta=25℃
Input Current	Pin	Vin=21.6V, Adim = 3.3V	-	-	5	Adc	after 2hr Warm up (1)
Output Current	Iout (Max)	Vin=24V, Adim=3.3V	6.3	6.8	7.3	mArms	
		Vin=24V, Adim=1.9V	4.8	5.3	5.8	mArms	
		Vin=24V, Adim=0V		20		%	
Backlight On/Off Control	On	ON/OFF=High	2.4	-	5.5	V	
	Off	ON/OFF=Low	-0.3	-	0.8	V	
Lamp Current Control	Dimmer	Min. Luminance	0			V	
		Max. Luminance	3.3				
PWM Signal	Fpwm	Vin=24, Vadim=3.3V		150		Hz	

Note (1) Module Temperature improvement Action :

This product Should be used Adim=1.9V, In Case of Adim=1.9V(Lamp Current Typ=5.3mArms) Luminance of White(center) Can meet Typ. 350cd

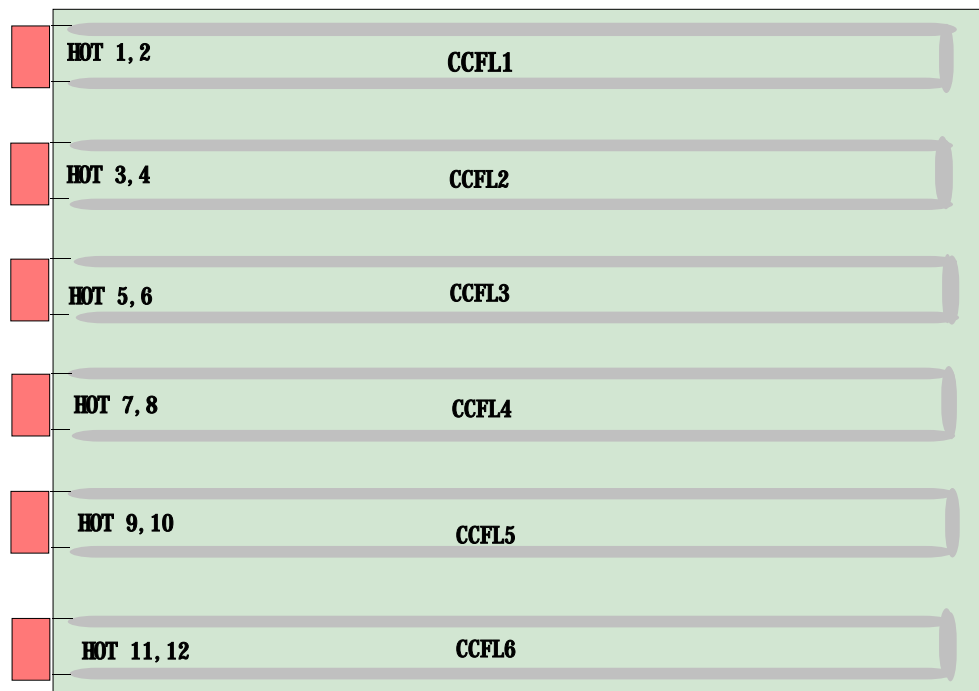
4. Block Diagram

4.1 TFT LCD MODULE



4.2 BACL-LIGHT UNIT

HOT : HIGH VOLTAGE (Part NO. : 20015WR-07B (Yeonho))



5. Input Terminal Pin Assignment

5.1. Input Signal & Power : Connector FI-E30S (JAE)

No.	Pin Name	No	Pin Name
1	N.C.*	16	GND
2	N.C.*	17	RxIN3-
3	N.C.*	18	RxIN3+
4	GND	19	GND
5	RxIN0-	20	N.C.*
6	RxIN0+	21	LVDS OPTION**
7	GND	22	N.C.*
8	RxIN1-	23	GND
9	RxIN1+	24	GND
10	GND	25	GND
11	RxIN2-	26	Vin
12	RxIN2+	27	Vin
13	GND	28	Vin
14	RxCLK-	29	Vin
15	RxCLK+	30	Vin

* N.C : Do not Connect. THESE PINS ARE ONLY FOR SEC INTERNAL OPERATIONS.

** LVDS OPTION : IF THIS PIN : HIGH (3.3 V) OR OPEN(NC) → NORMAL NS LVDS FORMAT
OTHERWISE : LOW (GND) → JEIDA LVDS FORMAT

Sequence : On = $V_{dd}(T1) \geq \text{LVDS Option} \geq \text{Interface Signal}(T2)$

OFF = $\text{Interface Signal}(T3) \geq \text{LVDS Option} \geq V_{dd}$

5.2. Inverter Input Pin Configuration

Connector :20022WR-14L(Yeon-ho)

PIN NO.	PIN Configuration (FUNCTION)
1	AWG24 24.0 V
2	AWG24 24.0 V
3	AWG24 24.0 V
4	AWG24 24.0 V
5	AWG24 24.0 V
6	AWG24 GND
7	AWG24 GND
8	AWG24 GND
9	AWG24 GND
10	AWG24 GND
11	N.C
12	BACKLIGHT ON ~ OFF / ON:2.4 - 5.5 V, OFF: -0.3 - 0.8 V
13	Max : 3.3V , Min : 0V
14	N.C

5.3 LVDS Interface

- LVDS Receiver : Tcon (LVDS Rx merged)
- JEIDA & Normal Data Format

LVDS Signal	LVDS pin	JEIDA -DATA	Normal -DATA
TxOUT/RxIN0	TxIN/RxOUT0	R2	R0
	TxIN/RxOUT1	R3	R1
	TxIN/RxOUT2	R4	R2
	TxIN/RxOUT3	R5	R3
	TxIN/RxOUT4	R6	R4
	TxIN/RxOUT6	R7	R5
	TxIN/RxOUT7	G2	G0
TxOUT/RxIN1	TxIN/RxOUT8	G3	G1
	TxIN/RxOUT9	G4	G2
	TxIN/RxOUT12	G5	G3
	TxIN/RxOUT13	G6	G4
	TxIN/RxOUT14	G7	G5
	TxIN/RxOUT15	B2	B0
	TxIN/RxOUT18	B3	B1
TxOUT/RxIN2	TxIN/RxOUT19	B4	B2
	TxIN/RxOUT20	B5	B3
	TxIN/RxOUT21	B6	B4
	TxIN/RxOUT22	B7	B5
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSNC	VSNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R0	R6
	TxIN/RxOUT5	R1	R7
	TxIN/RxOUT10	G0	G6
	TxIN/RxOUT11	G1	G7
	TxIN/RxOUT16	B0	B6
	TxIN/RxOUT17	B1	B7
	TxIN/RxOUT23	RESERVED	RESERVED



5.4 Input Signal, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY	DATA SIGNAL																										GRAY SCALE LEVEL
		RED								GREEN								BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7			
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	—	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	—	
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	—	
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	—	
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	—	
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	—	
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	—	
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0	
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1	
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓ LIGHT	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253	
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254	
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255	
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0	
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1	
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓ LIGHT	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G253	
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G254	
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G255	
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0	
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	B1	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B2	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B252	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	B253	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B254	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	B255	

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage



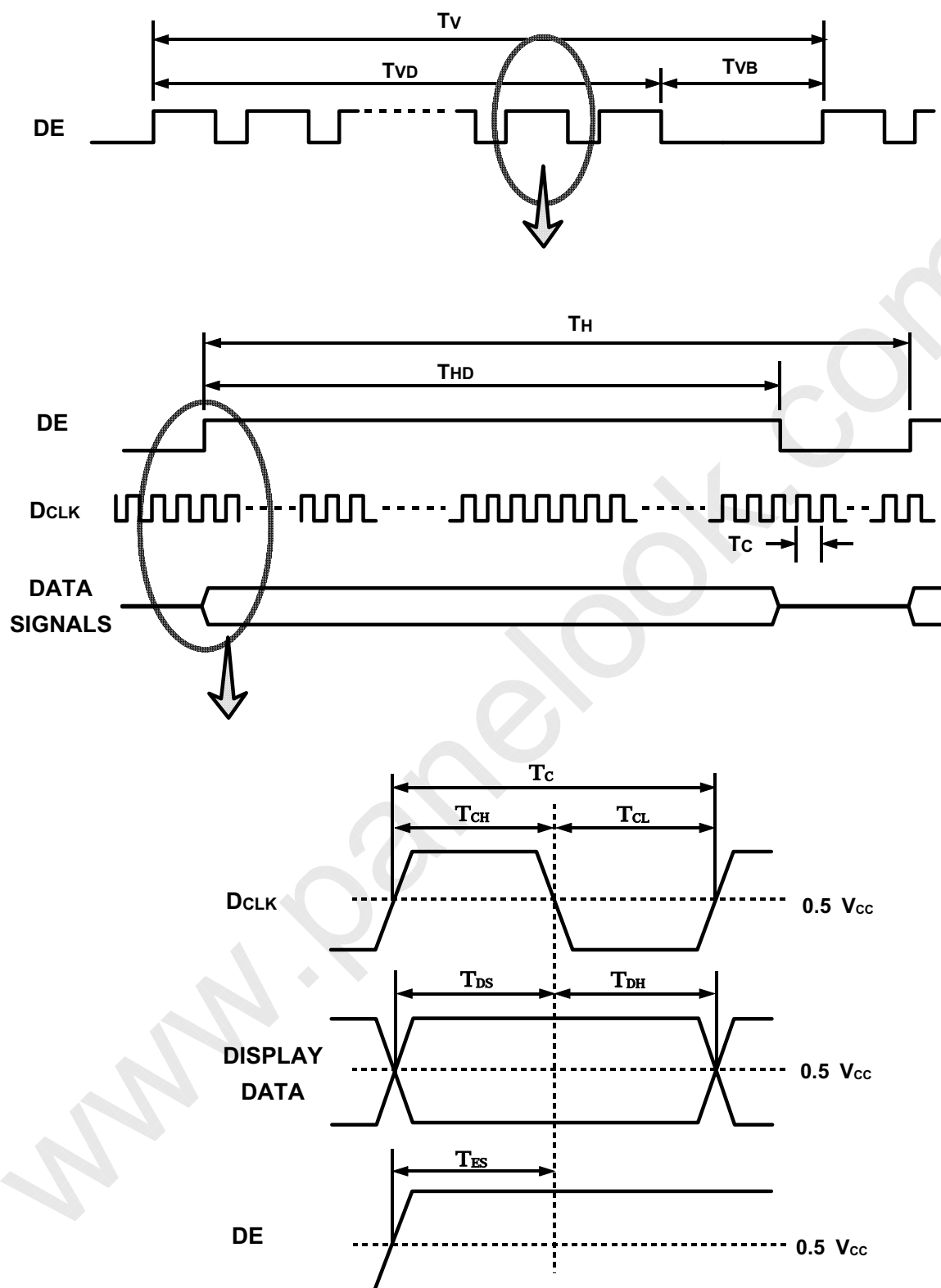
6. Interface Timing

6.1 Timing Parameters (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/TC	65	75	82	MHz	-
Hsync		F _h	44	48	53	KHz	-
Vsync		F _v	-	60	-	Hz	-
Vertical Active Disply Term	Display Period	T _{VD}	-	768	-	lines	-
	Vertical Total	T _V	773	838	-	lines	-
Horizontal Active Display Term	Display Period	T _{HD}	-	1366	-	clocks	-
	Horizontal Total	T _H	1570	1600	1700	clocks	-

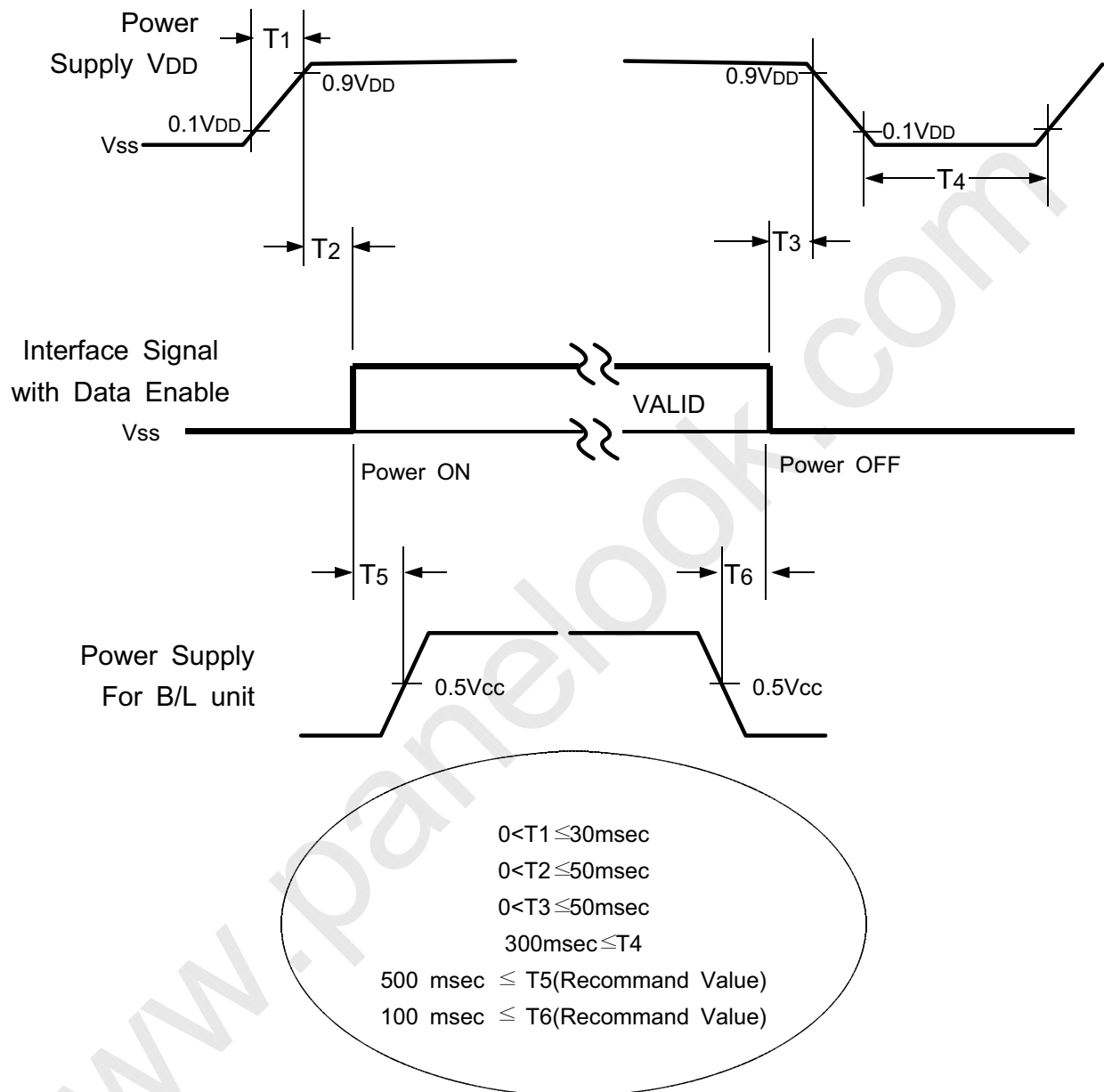
Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

6.2 Timing diagrams of interface signal (DE only mode)



6.3 Power ON/OFF Sequence

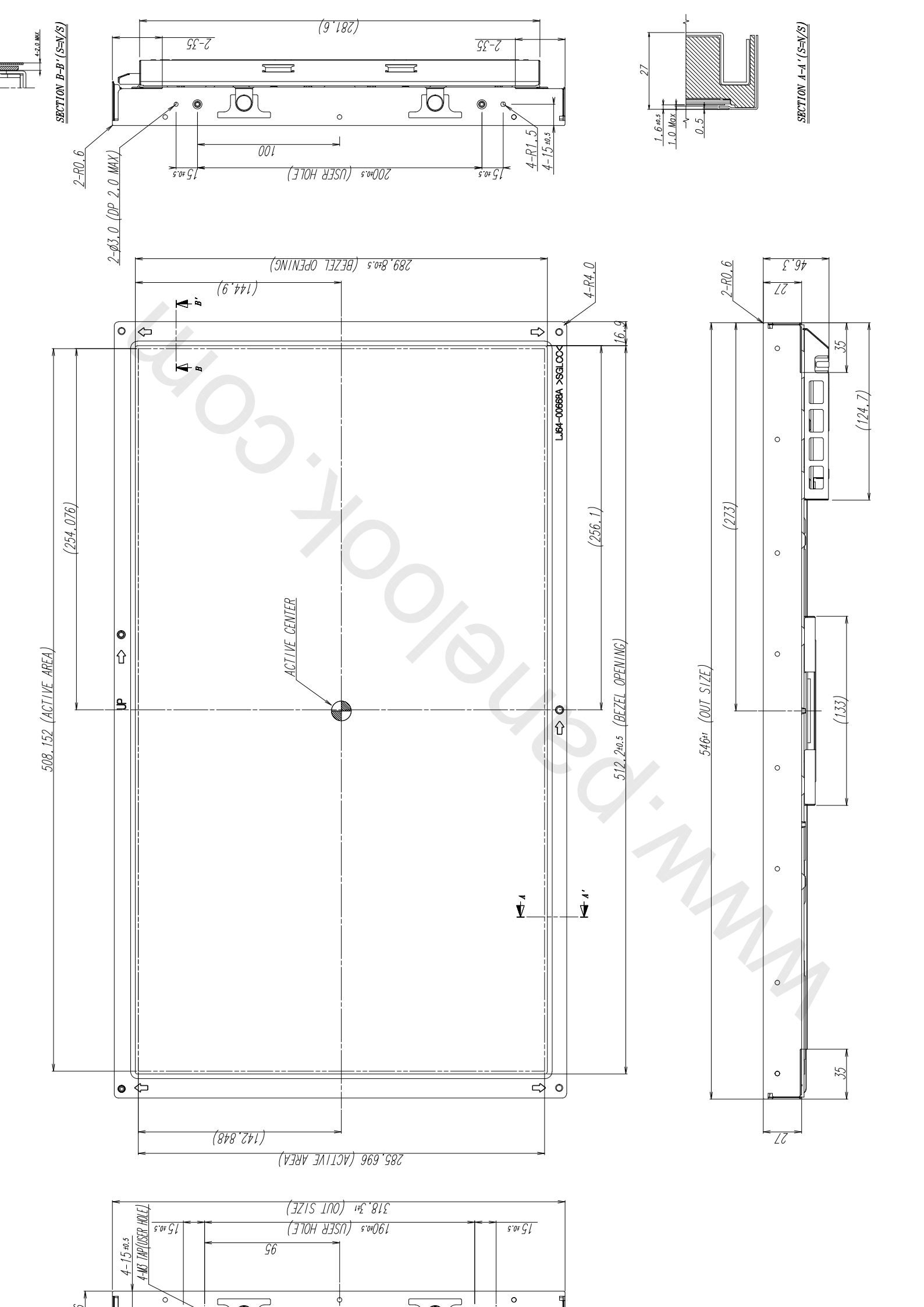
: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.

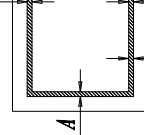


NOTE.

- (1) The supply voltage of the external system for the module input should be the same as the definition of VDD.
- (2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become abnormal screen.
- (3) In case of VDD = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.

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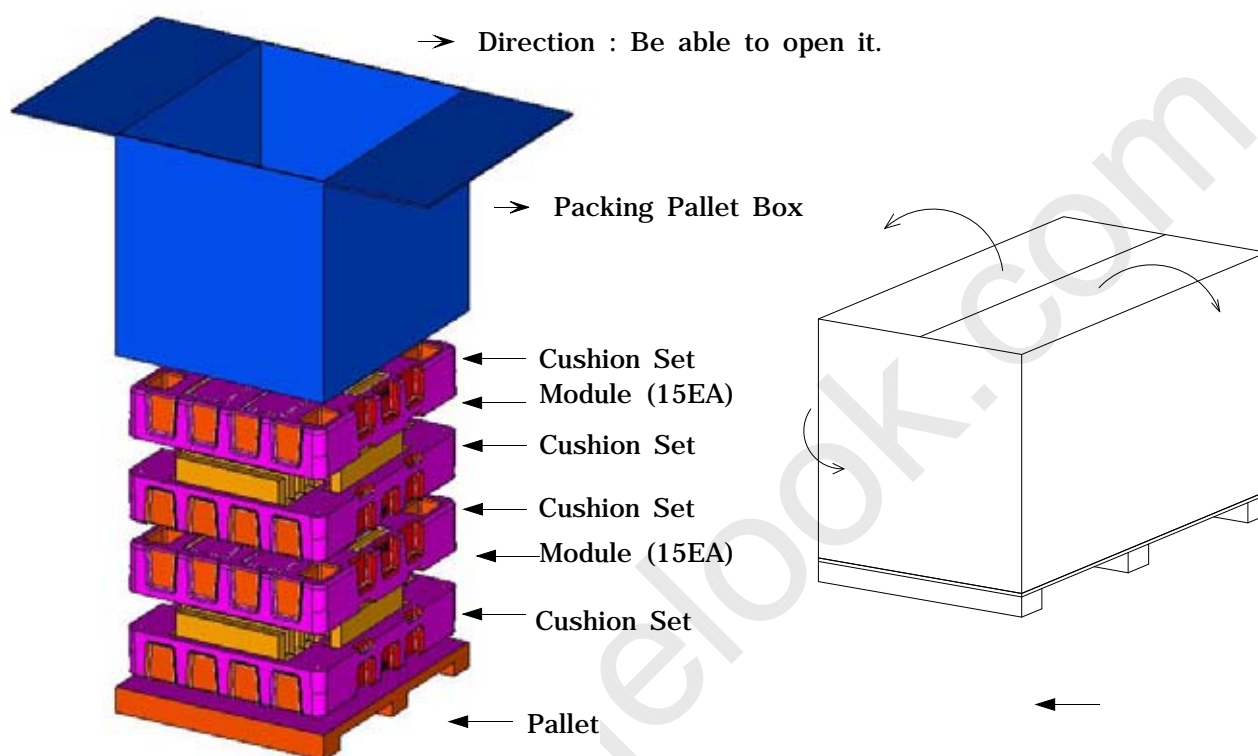




NOTE

1. BACKLIGHT : 6 COLD CATHODE FLUORESCENT LAMP
2. LAMP WIRE SPEC.
 - HOT : UL 3239 AWG24 DC6KV, $\phi 1.74$
 - COLD : UL 3239 AWG24 DC6KV, $\phi 1.74$
3. UNSPECIFIED TOLERANCE TO BE ± 1.0 .
4. USER HOLE: ALLOWED DEPTH OF USERHOLE SCREW
5. WEIGHT : Max 3.0Kg
6. GAP BETWEEN TOP CHASSIS AND GLASS IS 1.0mm
7. BLACK MATRIX SPEC
 - A = $2.024 \pm 1.0mm$
 - B = $2.024 \pm 1.0mm$
 - C = $2.052 \pm 1.0mm$
 - D = $2.052 \pm 1.0mm$

8. PACKING



ITEM	Specification	Remark
LCD Packing	30ea / Box (Packing- Pallet Box)	1. 3.0kg/LCD(30ea) 2. 3.2kg/Cushion Set(4ea) 4. 7.7kg/Packing- Pallet Box(1ea) 5. Cushion Material : EPS 6. Packing Pallet Box Material : DW4
Pallet	1 Box/Pallet	1. Pallet weight : 6.8kg 2. 110.5kg/Pallet , Total : 117.3kg/Pallet
Packing Direction	Vertical	
Pallet Size	H x V x Height	1150mm(H) x 985mm(V) x 1004mm(Height)

9. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

(1) Parts number : LTB230W1-L01-00R6

1 2 3 4 5 6 7 8 9

(2) Lot number : 6 Y 5 H 123 01 A

1 2 3 4 5 6 7

① 6 : Line

② Y : Device

③ 5 : Year

④ H : Month

⑤ 123 : LOT No.

⑥ 01 : GLASS No.

⑦ A : CELL No.

① LTB : Specialty Model

② 230 : Panel Size

③ W : WXGA

④ 1 : Generation

⑤ L : LVDS

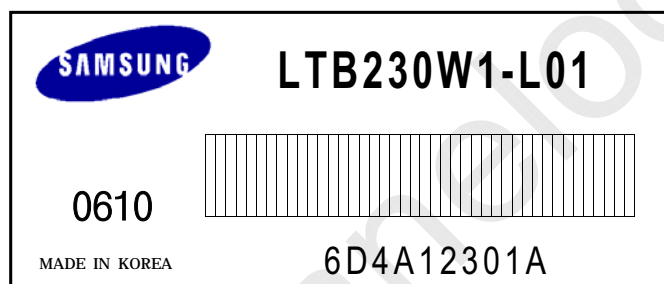
⑥ 01 : Derivation No.

⑦ 0 : Customer Code

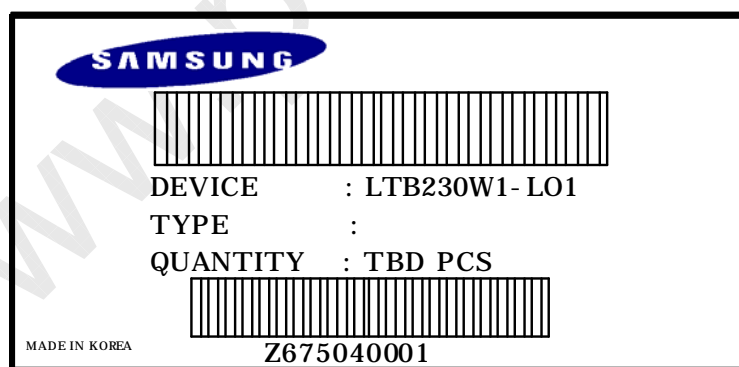
⑧ 0R : Revision No.

⑨ 6 : Line

(3) Nameplate Indication



(4) Packing Pallet Label



Z 6 7 5 0 4 0 0 0 1

1 2 3 4 5 6

① Z : PALLET

② 6 : LINE

③ 7 : CITE CODE

④ 5 : YEAR

⑤ 04 : WEEK

⑥ 0001 : SERIAL No.



10. General Precautions

10.1 Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
- (h) Protect the module from static , it may cause damage to the CMOS Gate Array IC.
- (i) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the module.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.

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10.2 Storage

- (a) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight.
- (c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

10.3 Operation

- (a) Do not connect,disconnect the module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the item 6.3 "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back-light connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

10.4 Operation Condition Guide

- (a) LCD product supposed to be operated under circumstance of normal condition.
Normal condition is defined as below;
 - Temperature : $20\pm 15^{\circ}\text{C}$
 - Humidity : $65\pm 20\%$
 - Display pattern : continually changing pattern (Not stationary)
- (b) When the product is used for special application where operates LCD products in a special condition - sever then normal temperature or humidity or operation time or display pattern -that may happen at Airport, Transit Station, Stock market, Bank, and Controlling system Etc, please contact SEC and take application AMLCD engineers advice. Otherwise, it may not be guaranteed its life time and function.

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10.5 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image "Sticks" to the screen.
We recommend that you should discuss SEC when you want the module to be operated in displaying the same pattern for a long time.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.